

**REPORT ON THE
EFFECTS OF ACRID
POISONS BY
THOMAS HODGKIN,
M.D**

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On the Effects of Acrid Poisons. By THOMAS HODGKIN, M.D.

THE British Association for the Promotion of Science having requested Dr. Roupell and myself to prepare a description, accompanied with delineations, of the effects of acrid poisons, we have both of us been desirous of complying with the wishes of the Society, but circumstances have retarded the production of our Report. Our researches have for mutual convenience been conducted separately, but the results have been submitted to and approved by each of us. A part of the Report now printed was presented to the Medical Section at the meeting in Edinburgh; the remainder was communicated to the Session in Dublin.

The object which the Association had more particularly in view in calling for this report was, I conceive, to facilitate the recognition of the effects of acrid poisons, with a view to aid in judicial inquiries of a very serious nature, and also to obtain a contribution to our knowledge of pathological anatomy, on a point which, though it has engaged the special attention of several able and acute observers, still demands further elucidation, viz. the pathological appearances of the mucous membrane of the alimentary canal. As a preparation for an exact knowledge of the appearances which may be produced in the mucous membrane of this canal by acrid poisons and other irritants, a correct knowledge of this membrane in its healthy state is essential; but here, on the very threshold of our inquiry we are met with a serious difficulty common to it, and every attempt to elucidate the morbid anatomy of the alimentary canal, the want of this accurate and definite knowledge of the different parts of the canal and of the different appearances which may be presented by each part within the limits compatible with health. If any proof of this assertion were wanting it might be found in the various statements made by anatomists respecting the colour of the mucous membrane in its healthy state. The youthful but able pathologist Billard, whose premature death has deprived our profession of one of its most promising cultivators, devoted great pains to the elucidation of this subject, and has pointed out the differences which arise when digestion is actually going forward and when it is not. Other differences doubtless proceed from circumstances connected with the mode of death, even when it has influenced the stomach merely indirectly. A wide range of appearances depends on this single cause. The blood may leave the vessels of the stomach,

and its lining membrane may be nearly or quite white ; or, on the other hand, they may be turgid by *cadaveric* congestion, and the lining membrane may be more intensely injected than in many cases of poisoning. Such differences though great are not more remarkable than those which are seen after death in the common integuments. It is however of the utmost importance that they should be well understood, since a mistake respecting them might seriously affect the reputation, if not the life, of a fellow-creature. The medical profession is greatly indebted to Dr. Yellowly, who long since called the attention of his brethren to this subject. The colour of the mucous membrane of the stomach is also very liable to be modified by its contents, which act on the blood in its vessels by transudation after death. This and some other circumstances to be hereafter mentioned have probably been the means of turning aside from the truth many able pathologists who have written on gastro-intestinal irritation, and more especially on chronic inflammation of the mucous membrane of the stomach. The researches of Dr. Stevens respecting the influence of different agents on the colour of the blood are well deserving attention in connexion with this subject, and appear to me to have thrown new light upon it. The colour of the stomach as well as many other parts may be greatly altered by exposure to the air after removal from the body.

The form and texture of the mucous coat of the stomach, which are of equal importance whether we regard the effects of disease or of poisons, appear to be involved in no less difficulty than the subject of the colour.

As a preliminary step to the right understanding of these alterations of texture we ought to be acquainted with those differences which depend in some degree on individual peculiarity, since the internal as well as the external teguments may admit of varieties of this kind. Still greater and more important differences are doubtless to be referred to the kind of diet which has been habitually employed ; here however an almost insurmountable difficulty presents itself, since the diet employed in this and in most other civilized countries is of so various, and at the same time of so mixed a character as to render it almost impossible to connect cause and effect with any degree of certainty. If the subject were not neglected, as appears to have been altogether the case, some clue might possibly be found in the observation and collection of extreme cases which from time to time present themselves, and some assistance might be derived in the way of analogy from experiments performed on inferior animals fed expressly for this purpose.

Some of the differences of form and texture which come under

our observation in *cadaveric* inspections must be referred to alterations which the texture undergoes after death, and these may be of two kinds, either occasioned by its own molecular changes or by the action of the contents of the stomach, which not merely alter the colour of the fluids in the vessels, as I have before stated, but materially affect the form and texture of the membrane with which they are in contact. Extreme cases of this kind have long since been pointed out by John Hunter as cases of the digestion of the stomach by its own secretion. Short of this extreme effect there are many proceeding to a less considerable extent which must not be overlooked. The difficulties which I have enumerated are still further increased by an imperfect knowledge of the structure of the lining membrane of the stomach. The surface of the mucous membrane of the stomach is generally described as villous, and even Billard appears to agree in this description of it. I have at least a doubt respecting the accuracy of this statement. To me the surface of the stomach from which its secretion has been carefully removed and its place supplied by a little clear transparent water, appears to be indeed by no means perfectly smooth, yet not to be strictly villous like the internal surface of the small intestines. It has an indeterminate character which it is extremely difficult to describe in words. In the serous membranes the assistance of a powerful microscope enables us to distinguish delicate fibres intimately interlaced; but when the mucous membrane of the stomach is thus examined I can only observe an amorphous semitransparent mass in which no structural arrangement can be distinguished; there is therefore little to be expected from this mode of examination. When the recent healthy membrane is immersed in clear water it becomes slightly thickened, but when gently pressed between the fingers it resumes its former thinness. This would seem to indicate that the water had penetrated a sort of areolar or spongy tissue, but had not intimately combined with it as with mucus itself or with some other aqueous secretion. Some idea of the texture of the mucous membrane of the stomach may be formed from the vessels which ramify through it, and which are liable from various causes to become injected and consequently visible. When this injection is neither intense nor universal, the vessels may be traced with the assistance of a lens or even with the naked eye. They exhibit a character which may not inaptly be styled dendritic, since they closely resemble the marks in Mocha stone to which mineralogists have applied this epithet. These injected capillaries in the mucous membrane of the stomach are neither so minute and delicate, nor have they so well-defined, even and clean an

outline as the vessels which we may see ramifying through parts having a more firm and definite texture, as, for example, beneath the surface of the serous membranes or in the completely formed and perfectly cellular membranous adhesions which inflammation is apt to superadd to them. In fact the vessels in the mucous membrane of the stomach to which I am alluding bear a very close resemblance to the early attempts at organization which we may perceive in the recent false membranes upon the surface of inflamed serous membranes before they have lost the character of coagulable lymph. The cause of the appearance in question seems to be the same in both instances. The imperfect vessels ramify through a soft and scarcely concrete substance, by which they are barely supported. They consequently become more dilated than the minute branches from which they proceed.

The mucous membrane of the stomach, even where not thrown into rugæ of greater or less extent by the action of what is usually called the muscular coat but to which I would give the name of contractile fibrous coat, seeing it is not composed of strictly muscular tissue*, is not perfectly even and level. When placed on a flat surface with its free surface uppermost, we may generally perceive very slight undulations of small extent and little elevation, such as at times to require a particular direction of the light to make them visible. The elevated spots do not appear to possess a very determinate arrangement. They are generally of an oblong figure and vary in size from that of linseed to that of rice. The intervening depressions are of less extent and often seem almost linear. I have been thus particular in attempting to describe the internal surface of the stomach, not merely because I shall have occasion to refer to the effects of poison on particular parts, but from a belief that some very able and laborious pathologists have been led to form erroneous opinions respecting certain appearances of this surface. This I conceive to be particularly the case with respect to the small elevations of which I have last spoken. They are much more distinct in some stomachs than in others, and when strongly marked they appear to constitute that state which Louis designates *mammillonné*, and which he regards as an advanced stage of inflammation. I had long been familiar with this appearance without knowing what precise value to assign to it, yet strongly doubting its necessarily inflammatory origin. I am now satisfied that it depends on the natural structure of this part of the organ; and that according to circumstances, of which it is important to

* See the Appendix to the translation of Edwards on the Influence of Physical Agents on Life, by Dr. Hodgkin and Dr. Fisher.

be aware, it may either be very conspicuous or all but imperceptible. This conclusion is drawn from the examination not of human stomachs only, but from that of different inferior animals, in which similar or closely analogous appearances are observable. They may be seen in the stomach of the dog, but the most conclusive evidence is perhaps to be drawn from that of the horse. The stomach of this animal, (as has been well stated by my friend Bracy Clark in one of the articles written by him for Rees's *Cyclopædia*,) though single, may be compared to the more compound stomachs of the ruminating animals. A large portion, consisting of nearly the whole of the cardiac third, is covered with a smooth but thick cuticle, continuous with that which lines the œsophagus. It is bounded by a thick, well-defined, elevated edge. The portion which succeeds to this and occupies the whole or greater part of the middle third, is void of cuticle, and differs very much according to the state of the animal at the time of death, and according to the length of time which may have elapsed between the death of the animal and the inspection of its stomach. It may be compared to the digesting stomach of the ruminants. The resemblance is the most manifest when the animal has been recently killed whilst the process of digestion was going forward. This part of the stomach is then seen to be best supplied with blood. The elevations in the mucous membrane to which I have been alluding as slightly marked in the human stomach, are here strongly marked and exhibit a manifest analogy with the honeycombed surface of the stomach of a ruminant animal, but on a small scale. A considerable quantity of thick mucus is poured out upon this surface, and seems to be the secretion of the membrane itself. A special follicular apparatus, if it exists, is so indistinct as to escape the most careful search. When the animal, though recently killed, has not been digesting at the time of death, the elevations in this part of the mucous membrane, though more strongly marked than in the human subject, do not so clearly present the analogy before spoken of, but are very similar in form and character to those which are met with in man. If the animal have been long dead, and the stomach have become completely collapsed and flaccid, the mucous membrane of the middle third of the stomach becomes so smooth that the irregularities in its surface are almost imperceptible. The injection of this part of the stomach in the two states last mentioned is liable to considerable variety, which I conceive must, like similar differences observable in the human stomach, be attributed to accidental causes. In some human stomachs examined at a very

early period after death the irregularity is such as to justify the appellation of *mammillonnée* which Louis has applied to it, whilst in the flaccid and long dead, and even in the recent stomach provided the secretions of the organ have acted upon the lining membrane, every trace of it is nearly or quite obliterated. I have observed the former or strongly marked state in the stomach of young persons in whom the idea of a chronic gastritis was inadmissible. At the same time I would observe that differences in the visibility and permanence of this irregularity of the mucous membrane of the stomach are met with to a sufficient extent to induce me to believe that stomachs differ among themselves in this respect independently of their being recently dead or having been engaged in digestion at the time of death. When the irregularities in question are strongly and permanently marked they may be regarded as the result of a real hypertrophy, since the membrane is not only firmer but thicker. This hypertrophy may often result from the use of certain kinds of food, but it seems also to be induced by other causes which occasion a determination of blood to the stomach. Thus, I have repeatedly met with it in stomachs which have been the seat of long-standing ulceration, even in those parts which do not appear to have the least participated in that state. I have also seen it in several cases in which hæmoptysis had repeatedly taken place; and I observe in the last fasciculus published by my friend Dr. Carswell, the representation of a part of the stomach of a person who had laboured under this affection which tends to confirm the remark which I have now made.

The last third or pyloric portion of the horse's stomach, like the middle, presents a somewhat uneven surface, but the elevations are much less both in height and extent. In fact it readily assumes almost an even surface, it is generally paler, and the mucus which lubricates its surface is less adherent and tenacious. I have sometimes seen indications of a very distinct follicular apparatus in this part. The human stomach, like that of the horse, generally becomes much less distinctly granular or uneven towards the pyloric extremity, and indications of a follicular apparatus may sometimes be seen, though I confess they are generally very equivocal. As I have taken some pains to discover how the human stomach is circumstanced with respect to follicular appendages, and as the subject is one on which I am persuaded a diversity of opinion exists, I shall take the liberty of making a further digression in order to say a few words respecting it. By some the existence of follicles is denied, by others certain appearances are regarded as indications of follicles

which I conceive ought not to be regarded as really possessing this character. Of the former class are some foreign pathologists. My friend Dr. Carswell appears to regard those elevations which I have been describing, and which when in a state of hypertrophy give to the mucous membrane of the stomach the character which Louis has designated *mammillonné*, as the follicles of the stomach, and the red spots which he has accurately described as sometimes occupying their centres he regards as the orifices of these follicles. I am induced to take a different view of these reddened centres. The mucous membrane of the stomach appears itself to be fully adequate to the production of mucus. Its follicles (if it possess any) are probably designed to bestow some peculiar properties on the juices of the stomach. We may therefore expect to find their situation occasionally pointed out by indications of a peculiar secretion at particular parts; and it is the fact, that we actually meet with such differences in the stomach rather than the actual demonstration of a follicular structure, on which I ground the opinion, which I offer rather as matter of conjecture than of absolute conviction.

The mucous membrane of the stomach sometimes presents small scattered spots, varying in size from about a twentieth to a tenth of an inch in diameter, from which the mucous membrane appears to have been removed, leaving a clean defined but by no means an elevated edge. Such spots are sometimes the commencement of ulceration, by which the stomach is actually perforated. They cannot, therefore, be regarded as the consequence of cadaveric solution. Spots are sometimes found scattered over the mucous membrane of the stomach scarcely exceeding in size those last mentioned, having a very slight depression, and rendered conspicuous chiefly by their colour, which is either dark brown or blackish. They are evidently produced by ecchymosis, and the idea that they are connected with a follicular apparatus is supported by the occasional existence of similar spots in the small intestines, where I have supposed them to be connected with the solitary glands. There is another appearance which I have met with in the stomach, and which though probably in degree *cadaveric*, concurs with the two preceding appearances to support the view which I have taken. I have found the mucous membrane of the stomach removed in numerous scattered spots having a circular figure, and varying considerably both in diameter and depth. They resemble the appearance which I first noticed in not having elevated edges, vascular areola, or other indications of ordinary ulceration, but they differ from them in appearing

to be more decidedly the effect of destructive solution. The edges were somewhat reduced in thickness. In some instances the mucous membrane was only rendered thin, in others wholly removed, and in the most advanced, the submucous cellular membrane was more or less removed, and the subjacent coat exposed. The surrounding cellular membrane, however, retained its healthy character, and allowed the free movement of the mucous membrane upon the subjacent coat, furnishing an additional argument against the inflammatory origin of the appearance which I have been describing. The exposed cellular membrane was generally of a pale almost milk-white colour, resembling that which is met with in the more extensive softenings of the stomach by the action of its own secretion.

I conceive that the appearance which I have thus described must have been occasioned by the operation of the follicular secretion. It may have commenced before death, but the symptoms of the case did not seem to warrant this idea, unless it were almost during the agony. The only difficulty seems to consist in the solvent process being confined to such limited spots, but this may perhaps be accounted for by the dissolving follicular secretion existing only in small quantity, though of intense quality, and, perhaps, on the membrane in the neighbourhood of the follicles having undergone some change by which it was rendered more susceptible of the influence of their secretion.

Since I have been engaged in the experiments which the request of the British Association has rendered necessary, I have met in the course of one of them with some appearances in the stomach of a dog which I regard as still further evidence in favour of the view which I have been laying before you. A dog was poisoned with oxalic acid in order to observe the peculiarities produced by this agent. In addition to other appearances which I shall have hereafter to notice, I observed numerous minute opaque white spots, which I could imagine to be nothing else than follicles which had become preternaturally conspicuous amidst the surrounding altered mucous membrane*. When we consider the great variety of appearances which the mucous membrane of the stomach may present independently

* I have since on two or three occasions met with the like appearance in the human stomach. The distribution of the minute whitish spots resembling that which was observed in the other appearances referred to a follicular apparatus; and the evident difference between these spots, and the granular or mammillar elevations before alluded to, and which were likewise strongly marked in one of these cases, afford considerable confirmation to the view which I have offered.

of the effect of any poisonous ingesta, and which are often quite as striking as those appearances which are met with when poisons have been known to be taken, we cannot but be sensible how fully medical men are justified when in cases of legal inquiry they hesitate to draw any positive conclusions from the state of the stomach itself, and lay the principal stress on the chemical analysis of its contents, as well as of that of the matter which has been rejected by vomiting, and of the articles of which those suspected of having been poisoned are known to have partaken. In this branch of inquiry great progress has been made of late years, and to no one in this country are we more indebted for it, than to Dr. Christison. Although it must not be expected that the report which the British Association has called for will throw that light on the morbid appearances produced by poisoning which will give to them a similar degree of certainty with that possessed by chemical analysis, yet I believe we may reasonably entertain the hope, that the various and multiplied experiments in which I know that my colleague on this occasion has been laboriously engaged will do much towards it. Some interesting conclusions appear to me to be pointed to, by the few instances of poisoning which have fallen under my own observation, as well as by the small number of experiments which I have as yet been able to make. These I will now proceed to lay before the Association, together with representations of the appearances observed, the fidelity of which does great credit to the artists by whom they have been produced. There are always painful feelings accompanying experiments on inferior animals, yet I trust that in making them we may be fully justified on principle, when the object in view promises to be an advantage to man, provided we are careful to seek the end in view with the least expense of life and with the least possible amount of suffering. I felt considerable difficulty in making choice of the animals to be the subject of these experiments, and have endeavoured as far as possible to take those lives which for other reasons it was either necessary or desirable to sacrifice. Another point to be kept in view in selecting the objects of experiments is, that the animals may be such, that the conclusions to be drawn from them may with a good degree of analogy be applied to man. Dogs have in general been selected for this purpose; and their size, their sufficient degree of tenacity of life, and their patience under suffering warrant this choice. I have made some attempts with cats, supernumerary and worthless animals of this species being more easily obtained than in the case of dogs; but their extraordinary tenacity of life and the readiness with which they

reject from the stomach whatever offends it, induced me, after having unsuccessfully attempted to poison four of them with arsenic, to desist from making them the subject of experiment. It appeared desirable to employ an herbivorous as well as a carnivorous animal, and for this purpose I selected the horse, as the most accessible animal of sufficient size; and though his stomach differs materially from that of man, I conceive that the choice has not been an useless one.

Of the Modus Operandi of Poisons.

This subject having been made the object of very careful inquiry by my friends Dr. Addison and John Morgan, with the result of showing that the influence of poison depends rather on a power exerted through the medium of the nerves, or by sympathy, than on the contamination of the circulating fluids by absorption, I have not thought it necessary to direct my attention to it in the experiments which I have made. There was one point, however, which appeared to me to be worthy of attention in reference to the *modus operandi* when the stomach is the organ acted upon by poisons, viz., Are the effects produced to be attributed to the mere injury of the organ, connected as it is with the rest of the system by the most astonishing sympathy; or is the principal stress to be laid on the specific action of the poison? The fact that a number of persons have been killed by drinking boiling water, who have died exhibiting many of the symptoms of poisoning, shows that the lesion of the stomach without specific influence is a very adequate cause of speedy death: still I was desirous of ascertaining the degree and extent of the mischief induced by this cause compared with what takes place when a poison is employed; I therefore had three ounces of water nearly at the boiling-point thrown by means of a syringe into the stomach of a small and young dog. It was almost instantly returned nearly as clear as when received, and still at a high temperature. After having thus rejected the water, the dog exhibited so little symptoms of uneasiness that I almost suspected that little or no mischief had been inflicted; but in a short time he made efforts to vomit, and rejected a clear fluid somewhat frothy and mixed with a little coagulated secretion resembling lymph or slightly heated albumen; he continued to repeat similar efforts at various intervals, the matter rejected bearing the same character as before, but occasionally tinged with blood. He appeared at times to suffer inconvenience in his throat, but his sufferings did not seem to be very severe; they appeared, however, to be on the increase

rather than on the decline, and about three hours after the water had been given, I found him weak, inclined to remain quiet, and with the upper part of the abdomen remarkably swollen, whilst the lower was as much contracted. The efforts to vomit were less frequent. Though cheerful when noticed, he had become cool and languid. Judging that the lesion of the stomach had now arrived at its height, and that death was inevitable, I had the animal killed by a blow on the head. On examining the stomach and œsophagus they presented an appearance which has been well represented by C. J. Canton. The œsophagus was of bright red, but its cuticular lining was not detached; its parietes were very much thickened by infiltration with a colourless fluid, constituting true inflammatory œdema, and bearing considerable resemblance to œdema of the glottis which is seen in man, except with respect to the redness and injection, which in œdema of the glottis in man are often wanting. The stomach was more intensely reddened than the œsophagus. It was distended with a considerable quantity of transparent but ropy secretion, but its parietes were not much thickened. The redness was far more intense towards the cardiac extremity, where blood appeared to be extravasated as well as injected. Towards the pylorus the discolouration was comparatively trifling.

The situation of the most intense effect produced by the irritation of hot water tends to confirm some observations which I have had occasion to make in examining the stomachs of persons poisoned by sulphuric acid, and leads me to offer a few remarks on

The Inferences to be drawn from the Situation of the principal Lesion of the Stomach in Poisoning.

In the cases to which I have alluded, the principal action of the boiling water and sulphuric acid were observed in the greater curvature immediately opposite the orifice of the œsophagus, rather than precisely at the cardiac extremity, where, in other cases, the most intense injection is generally met with. The repeated occurrence of this fact induces me to suppose, that when an intensely active agent, like the two which I have mentioned, has been swallowed or forced into the stomach, it is, as it were, discharged against that part of the internal surface of the stomach which is immediately opposite the opening, and that upon this spot an almost instantaneous effect is produced, which is deeper and more intense than that which is afterwards produced on other parts of the mucous membrane, when the agent is diffused over them, lowered in its activity by the mucus, which is rapidly secreted, and which does not merely dilute the

noxious agent, but in some degree protects the membrane. The fact that the spot which I have now pointed out is not precisely that at which the highest degree of vascularity is generally met with, may induce us to regard the discovery of a morbid appearance at that spot as a ground of suspicion that some fluid capable of producing an immediate effect has been received into the stomach. Even when the noxious agents received into the stomach do not produce the immediate effect which I have noticed in the case of boiling water and sulphuric acid, some inferences may be drawn from the situation of the morbid appearances. If the poison have been taken in the solid form, as, for example, when arsenic has been taken in substance, strongly marked effects will be produced at those particular spots on which the poison has lain, whilst the intervening portions either escape, or exhibit much less striking effects. If, on the other hand, the poison be taken in solution, and be not sufficiently intense at once to destroy the power of the stomach, its effects will be found most conspicuous in those parts which, under other circumstances, are the most frequent seat of injection, namely, the cardiac extremity, or even the whole cardiac half and the summits of the rugæ. In fact, the inflammation of the stomach produced by an irritating poison in a fluid form, and not acting immediately as an escharotic, appears to resemble that which takes place in the mucous membrane of the alimentary canal when no poison has been taken. At least the principal difference appears to exist in the superior intensity of the appearances which are occasionally observed in cases of poisoning. It is perfectly consistent with this remark, that we not only find the rugæ of the stomach reddened, especially at their summits, but also the edges of the valvulæ conniventes most intensely injected when the effect of the poison is continued into the small intestines. In the horses which I have had poisoned the orifices of the biliary and pancreatic ducts, which are marked by slight projection on the internal surface of the duodenum, were similarly reddened. The wax model of the stomach of a horse poisoned by corrosive sublimate given in solution, exhibits in a well-marked degree the effects of a fluid acrid poison; it is also worthy of attention that it is not merely the summits of the larger elevations, such as the rugæ of the stomach and the projecting orifices of the ducts, which become conspicuous by their superior injection, the summits of those smaller elevations to which I have called particular attention in describing the character of the internal surface of the stomach sometimes become similarly distinguished.

There is one circumstance in connexion with the redness and

injection of the mucous membrane of the stomach which appears to me to be worthy of attention, as affording in some instances a ground of distinction between the effects of decided inflammation and mere congestion. As far as I am aware, it has never been particularly pointed out. When an intense and diffused inflammation of the mucous membrane has been excited, the membrane is liable to be not only reddened by injection and thickened by the afflux of fluids to it, but an interstitial deposit of lymph seems to take place, which produces the appearances of small irregular opaque whitish spots in the substance of the membrane itself. I do not know that I can better describe the appearance which I wish to point out than by a simple comparison. In thinnish gruel, prepared with oatmeal, we have a translucent viscid fluid, through which small opaque whitish particles are diffused. Let us suppose the translucent fluid to be coloured by lake, or some other suitable pigment which does not destroy translucence, and the appearance to which I allude may be readily conceived. In cases of simple congestion, such as are produced by affections of the heart or other causes disturbing the circulation, and in cases of great irritation without the deposition of lymph interstitially, we may have redness and injection to a great degree of intensity, but without the accompanying irregular opaque spots in the substance of the mucous membrane.

The appearance which I have just described was very conspicuous in the stomach of a man who had poisoned himself with hydrocyanic acid. Of the strength and quantity of the poison which he had taken I am unable to speak. It produced speedy, but not immediate, death. The inspection was not made by myself, but the stomach very shortly after its removal from the body was brought to Guy's Hospital, and the appearances which it presented were carefully copied by the very accurate pencil of C. J. Canton. At the same time I must observe that the appearance in question is so intimately connected with the structure of the membrane as to render a perfect delineation almost impossible. Similar, but rather less conspicuous, interstitial opaque spots were observed in the stomach of an elderly person who had taken arsenic. This stomach was, like the former, not met with in one of my own inspections, but was brought to me some hours after its removal by an able anatomist, who had conducted the examination. This circumstance, as well as that of the arsenic having been taken, as it was supposed, in fluid form, may account for the absence of some of the other appearances which are often, and perhaps

generally, seen in cases of poisoning by the swallowing of arsenic.

The character of the secretion upon the surface of the mucous membrane will sometimes throw considerable light on the condition of the membrane before death. In the case of the dog which had received boiling water, we have seen that a large quantity of fluid was secreted, since the stomach was found distended with it, and a considerable quantity had also been rejected by repeated vomiting. Not only the quantity but the quality of the secretion was altered, for besides the clear and glairy fluid, there was also some opaque and partially coagulated matter, which appeared to consist of lymph. The fact that none of this was found in the stomach after death shows that it did not attach itself to the lining membrane in the form of a false membrane;—the abundance of the fluid secretion, combined with the continued and forcible action of the contractile fibrous coat, having probably been the cause which prevented its doing so. In other instances, when the irritating cause is very active and remains applied to particular spots, the secretion is rather lymph than mucus, and remains attached to the lining membrane, except under particular circumstances, which I shall have to notice in one of the cases I am about to relate.

The presence of a small quantity of blood in the matter secreted is equally worthy of attention with the production of lymph instead of ordinary mucus. In whatever way the escape of this blood is brought about, it is an evidence of the violence of the injury which the mucous membrane has received. It would appear, however, that it takes place in two modes, which deserve particular attention. In the one case the vessels seem to give way under the immediate influence of the violence which they receive, as well as from considerable and sudden injection. The hæmorrhage in this case resembles that which takes place from mechanical injury, or more closely that from the Schneiderian membrane which occasionally takes place under violent exertion. In the other case to which I allude, the escape of blood is the result of a more slow and gradual process. It appears to be brought about by the alteration of structure which takes place as the result of the inflammation which the irritating cause has created. The blood escapes from numerous minute points at which the redness is most intense, the substance of the membrane having become soft and tender, though somewhat thickened.

It is this softening of the texture, the result of inflammation,

and which prepares the way for the escape of blood at numerous points, which appears to me to be worthy of particular attention, since it seems quite analogous to that which takes place in acutely inflamed serous membranes when plastic lymph is thrown out and is about to become organized. In the case of the serous membranes, these numerous and minute extravasations of blood into the closely applied or adherent lymph appear to be the first stage by which the organization of the false membrane commences.

I shall now proceed to relate some of the cases and experiments which have furnished the opportunities of producing the drawings and models which I have to submit to the inspection of the Medical Section.

12—10^{mo}.—1829. *Guy's Hospital*.—No. 1.—Examination of the body of William Robert Squires, æt. 16, admitted into Luke's Ward on the 11th, and who died about twenty-six hours after having swallowed arsenic by accident. It appears that on the morning of the 10th he picked up a piece of cheese which his master had charged with arsenic and placed as a poison for rats. Having shaken or blown it to get rid of the dust or flour which he thought was upon it, he swallowed it. He afterwards took his dinner and went to his work, but was seized with vomiting and tormina. The cause of his illness was not suspected until the following day, when the lad's master discovered that the poisoned cheese had been removed. He was brought to the hospital, and two 5-grain doses of sulphate of zinc were given. They produced vomiting of bilious matter, mixed with a flake or two of a substance resembling a semitransparent membrane, spotted with blood. A blister was then applied, but he died almost immediately after. His pulse was very quick, but his symptoms, even a short time before death, did not appear very urgent. He had passed stools, and had complained of pain of head, but not of heat of the throat.

The appearance of the body indicated an age less than that assigned to the lad. The body was in good condition, but mottled with rather light-coloured irregular livid spots.

Head.—The head was not opened.

Chest.—The viscera of the chest were healthy, but the lungs exhibited considerable cadaveric engorgement. The remains of the thymus gland were large. The heart was rather small and contracted. It contained some coagulated blood.

Abdomen.—There was a generally diffused light rose-colour over the greater part of the exterior of the intestines, but it appeared rather to receive the tinge from congestion than from inflammation, not being attended with any effusion of lymph or other product of inflammation, and not particularly affecting parts in contact, but portions of the whole calibre at intervals, which generally occurred in depending portions, were of a deeper colour than the rest. The interior of the œsophagus was to all appearance healthy, or at most of a very faint rose-colour. The mu-

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coys membrane of the stomach was corrugated, and exhibited extensive deep and bright injection, not nearly so uniformly diffused as is often the case, but most considerably affecting the rugæ. The middle third was the most considerably affected, but there was no marked difference at that part which is opposed to the cardiac orifice. There was no decided abrasion, but at two or three small points the effused lymph was adherent. The pyloric extremity was the least reddened, but at this part the follicular glands were elevated and very distinct. The stomach contained a considerable quantity of watery bilious fluid, and a mass which appeared chiefly to consist of a coagulated secretion resembling the plastic lymph on the surface of an inflamed serous membrane. It was about the size of the palm of one's hand, and had very strongly received the impression of the rugæ of the stomach, and the surface in contact with the lining membrane closely resembled it in colour and in the distribution of the extravasated blood intimately intermixed with it on this surface. The other surface resembled common coagulable lymph, but entangled in it there was a fragment of what appeared to be partially dissolved cheese, mixed with numerous particles of white opaque matter. A small quantity taken from this part, dried and mixed with black flux and heated, afforded a distinct trace of sublimed metallic arsenic. Another portion, reduced on charcoal before the blowpipe, yielded the alliaceous odour. There was a diffused and light but not bright redness of the duodenum. A similar condition, but in a much less marked degree, was observable throughout the small intestines, in which the solitary glands were particularly distinct; there was scarcely any fecal matter in the canal, but there was abundance of secretion, which in its character appeared intermediate between ordinary mucus and coagulable lymph. There was a slight degree of œdema of the submucous cellular membrane. The large intestines were of a more natural appearance. The mucous membrane was generally pale, but there was a manifest increase of redness about the verge of the anus. Many of the mesenteric glands were much enlarged. The structure of the liver appeared to be healthy, with the exception of some scattered ecchymosed spots, obviously of recent formation, and a little dappling of a lighter colour. The gall-bladder was distended with rather dilute bile. The spleen and pancreas were healthy, as were also the kidneys and bladder, excepting some increased vascularity of the mucous membrane of the bladder near the cervix at the posterior part.

The points worthy of remark in this case appear to be: 1st, That though a considerable quantity of arsenic had been taken, the symptoms which followed were not proportionably urgent and rapid. For this there appeared to have been at least two causes. The cheese in which the arsenic was involved having resisted digestion, seems to have prevented much of the arsenic from coming in contact with the stomach. The food which was taken almost immediately after the swallowing of the poison may have also acted in a similar manner. It may also have had the effect of exciting the healthy action of the stomach by setting up the digestive process: this appears to be analogous to what takes place in horses which have eaten the leaves of the yew tree, which are

an active poison to horses and other cattle. They generally die in a few hours after taking this poison; but it has been shown by my friend Bracy Clark, that if food be taken in conjunction with, or immediately after, the yew leaves, the injurious effects do not follow, but the poison and the food appear to be digested together. The second point is the complete illustration of the remarks which I have offered respecting the production of coagulable lymph, and of the escape of blood from minute points on the inflamed surface.

3rdly. The detachment of this layer of lymph from the mucous surface, which was probably brought about by the efforts to vomit, renewed with increased energy by the emetics of sulphate of zinc. This is a practical point, bearing on the use of emetics and the mode of employing them*.

No. 2. This case occurred so recently as the 21st of last month, (August, 1834.) It is that of a middle-aged man who like the lad in the preceding case had taken arsenic.

22—8mo.—1834. *Guy's Hospital*.—Examination of the body of A. B., aged about 35 years, a patient of B. B. Cooper's in Accident Ward, admitted on the 21st, a short time after he had taken about an ounce of arsenic. He was a man of dissolute and intemperate habits and took the arsenic whilst in a state of intoxication. Vomiting had taken place in about half an hour after he had swallowed the poison. On medical assistance being obtained, the stomach-pump was freely employed; he was afterwards removed to the hospital, where an emetic of sulphate of zinc was administered and acted pretty freely. The patient was then perfectly sensible, and endeavoured as far as lay in his power to cooperate with the means employed for his recovery. Besides the emetic a considerable quantity of chalk was given to him. He was affected with purging as well as vomiting. His first stools were not seen, but those which he afterwards passed contained much jellylike mucus. He passed some urine, the character of which was not noticed. The abdomen was somewhat painful when pressed.

He sunk in a state of collapse about midnight.

The external appearances presented nothing remarkable. The body was in good condition as to flesh, and its surface generally pale.

The head was not opened.

The pleura on the right side was almost universally adherent by a firm old adventitious cellular membrane. The left was perfectly free from adhesions; there was little or no serum in its cavity. The substance of the lungs appeared generally crepitant and healthy, but posteriorly there was a good deal of sanguineous engorgement, having very much the character of pulmonary apoplexy. In the anterior portion of the lung were one or two rounded portions having completely this character. The pericardium contained some straw-coloured serum. The heart was large, but neither remarkably gorged nor contracted; the right auricle was rather distended; the blood in the right ventri-

* A drawing of the rejected portion of lymph illustrated this case.

cle was partially coagulated with some separation of fibrin. The peritoneum was partially minutely injected, especially towards the cardiac extremity of the stomach, and on some of the convolutions of the small intestines. The branches of the mesenteric veins were somewhat distended. There was a small quantity of straw-coloured serum in the lower pelvis, with some tender diaphanous films of coagulable lymph which retained the serum in its meshes. (This lymph may have separated from the serum by coagulation after death.) The stomach was flaccid and slightly distended, containing air and dirty turbid chocolate-colour fluid in which were some gritty matter, and softer whitish powder, probably chalk. There was no concrete mucus or lymph adherent to the internal surface of the stomach. The mucous membrane was generally of an intense red colour, deepest about the middle towards the smaller curvature, a little less so at the cardia, and considerably less towards the pylorus and greater curvature. The redness was not altogether diffused, but for the most part assumed the character of a dendritic capillary injection. In some instances this redness was most intense where rugæ appeared to have existed. Along the greater curvature and a little towards the pylorus the remains of the rugæ were very evident and of a livid or chocolate colour, the substance of the mucous membrane being considerably thickened along their course. The surface of the membrane generally was slightly granular; there was no appearance of abrasion produced either by the poison or the stomach-pump. The mucous membrane did not appear particularly soft, but was perhaps a little thickened. In the injected parts between the distended dendritic capillaries there was a small appearance of white opacity, suggesting the idea that a little lymph had been separated in the substance of the membrane. This appearance was less distinct than in some other cases of a similar kind. The duodenum was mottled with red colour, but not by any means intensely injected. Throughout the small intestines there was a marked redness approaching to lilac and of a light colour in the course of the valvulæ conniventes. The mucus which they contained was rather thick, grumous and turbid, but by no means ropy. The aggregate and solitary glands were not particularly developed. The mucous membrane of the colon as far as it was examined was pale and covered with thick mucus. Towards the rectum, and in that intestine, the mucous membrane was a little injected in spots; this was most considerable towards the anus. The mucous membrane at this part resembled paste, and had very little odour. The mucous glands were developed. The liver was rather large, of a mottled yellow colour, with a granular appearance, having a good deal of the character of liver met with after the abuse of mercury, the acini assuming the form of small rounded bodies: in some spots there were contraction and induration of the intervening substance, and one or two small semicartilaginous bodies imbedded in its substance near the surface; they were probably the effect of blows or some other old local injury. The gall-bladder was distended with greenish bile; no trace of bile had been observed in the alimentary canal. The pancreas was healthy, but perhaps more coloured than is usual. The spleen was of moderate size and apparently healthy. The kidneys were

healthy, but rather injected. The bladder was contracted, and its mucous membrane a little injected, especially towards the cervix, where the veins were distended.

The principal points of consideration which this case suggests are, 1st, the greater rapidity with which death followed the taking the poison; 2nd, the differences in the appearances observed after death, consisting in the more general diffusion of redness and injection, and in the absence of plastic lymph; 3rd, the different mode of treatment, consisting in the use of the stomach-pump and the liberal use of emetics, to which may be ascribed the removal of the coagulable lymph, had it been thrown out, and the application of arsenic in solution to almost every part of the stomach instead of partially in a solid form.

The contents of the stomach and small intestine of this patient were very carefully examined by R. H. Bretts, a pupil at Guy's Hospital, who has devoted great attention to chemical research. I need not detail the process to which he had recourse. There was no difficulty in the discovery of arsenic in the stomach, from which some remains of the white oxide were taken. The presence of the arsenic in the intestine was made certain, but not without considerable difficulty, and its quantity appeared to be very minute. On this I would lay some stress, as in the experiments which I have next to relate, the one on a dog, the other on a horse, no arsenic could be discovered in the intestines though carefully sought by equally practised analysts.

No. 3. The next example of poisoning by arsenic which I shall relate is that of a dog, and here I would observe that I met with considerable difficulty before I succeeded in having a dog killed with this poison; for although they do not at first refuse to take either liquid or solid food with which arsenic has been mixed, yet having taken it they readily reject it from the stomach, and then appear to grow suspicious and generally refuse further doses. I at length succeeded, with the assistance of T. Davis, by giving repeated doses, so small as to be disguised, at the intervals of an hour each to a hungry dog. He retained some of the doses for an hour and half or more. He vomited after each. He survived the first dose more than twelve hours; but as he died in the course of the night when he was not watched, it is impossible to state the exact time. In the stomach of this dog, which was examined the following morning, the mucous membrane was found deeply reddened towards the cardiac extremity and in other parts, to some of which the arsenic in substance was attached, being intermixed with the secretion, which in some respects resembled coagulable lymph and assumed the form of a false membrane. When this layer was fresh raised from the surface of the membrane the inflamed and reddened texture was of a bright colour. When the secretion had been previously separated, the membrane, coloured by injection or extravasation, presented a deeper hue. The viscid as well as more solid exudation from the surface of the stomach was somewhat tinged with blood, some of the particles of which were examined by my friend J. J. Lister; they had not wholly lost their form, but the regularity of their outline was considerably impaired.

Though this blood had doubtless escaped from some portion of abraded

surface, I did not discover any spot in which abrasion had taken place. Almost every part on the intestinal canal of this dog exhibited more or less injection of a bright colour. In the higher portions the redness occupied nearly the whole surface, but lower down it strikingly marked the summits of the rugæ. The mucous glands towards the termination of the rectum were considerably enlarged. The contents of the intestinal canal were examined by G. O. Rees, but no trace of arsenic could be detected even in the small intestines*.

No. 4. This illustration I take from the case of a horse which received 2½ ounces of arsenic rolled up in dry paper. In four hours the effect of the poison was strongly shown; and in the evening, ten hours from the time at which it was given, the animal died. The stomach was examined the following morning. It was distended with masticated hay, mixed with a moderate quantity of fluid. A considerable quantity of the arsenic in substance was found about the greater curvature rather more than one third from the pylorus, and consequently applied to the second and third portions of the mucous membrane. Traces of the arsenic were evident in many other parts of the stomach, although it was nowhere collected in substance as at the spot just mentioned. The greater portion of the mucous surface of the middle third was covered with a tenacious layer of secretion intermediate between lymph and mucus. It was nearly white when applied to the stomach, but the other surface was discoloured as well as roughened by the intermixed and adherent particles of food. The mucous membrane beneath this layer was deeply coloured with blood in those parts with which the arsenic appeared to have been in contact, whilst over a large surface in which this was not the case, the membrane, though not white, did not seem to be morbidly coloured. The summits of the rugæ and other prominent portions of the mucous surface, both in the third portion of the stomach and in the pylorus, were especially reddened. This was the case with the orifices of the biliary and pancreatic ducts. That portion of the stomach which is covered with a strong cuticular lining did not appear to be at all affected. Most of the bots, of which there were several in this stomach, were still alive. There was some redness in the course of the alimentary canal, but it was neither intense nor otherwise remarkable. The contents of these intestines were very carefully examined, but no arsenic was discovered.

No. 5. A second horse received a portion of arsenic in the same manner as the preceding, except that instead of being allowed to die he was killed in four hours, before he had betrayed any symptom of derangement from the dose which he had taken. The stomach was soon after examined. It contained about the same quantity of food as in the former case, and the arsenic in substance was found collected in precisely the same part of the stomach. A considerable portion, however, had also passed the pylorus. The appearances observed in this case were very similar to those observed in the preceding instance, but they were much less intense. The same kind of tenacious layer covered the greater

* Wax models by Joseph Towne illustrated this and the following cases.

part of the middle portion of the organ. Its free surface was discoloured with intermixed and attached particles of food, but the thickness of this layer was much less than in the former case. The membrane beneath it was but slightly discoloured, except where immediately in contact with the arsenic. That portion of the poison which had passed into the duodenum was implicated in a mass of coagulated lymph pretty firmly adherent to the surface of the membrane; on raising it, the under surface presented numerous bright red bloody points, and a similar appearance was seen on the membrane from which it had been detached. Lower down in the intestinal canal I did not discover anything remarkable. I must not omit to observe that in the stomach of the horse, where no poison had been taken, the viscid adherent mucous secretion is liable to be discoloured on its free surface by adherent particles of food, but a little careful attention will distinguish this layer from the more membranous character of that produced when arsenic has been given.

The 6th example which I shall bring forward is that of a horse poisoned with corrosive sublimate, which was given in solution in gruel. The symptoms in this case were at least as urgent as in the first case of poisoning with arsenic. I have already remarked some of the peculiarities distinguishing this form of poisoning from that in which a solid irritation is applied to the mucous membrane.

The 7th case is of a very different character from the six preceding, and appears to me to be worthy of particular attention. A pretty strong solution of oxalic acid, containing, I believe, rather more than a dram of the crystallized acid, was injected into the stomach of a dog as in the case of the boiling water. The effect was immediate, and death took place in about a quarter of an hour, with symptoms which I did not witness and cannot now relate. Death in this case was more speedy than I had anticipated, and I was consequently not prepared to examine the body for rather more than twelve hours after it had taken place. At the opening of the abdomen I was struck with the dryness of the peritoneum and the general paleness of the contained viscera. This was particularly the case with the intestinal canal. The fat of the epiploon and other parts within the abdomen was also remarkably firm and white. The cardiac extremity of the stomach was flaccid and exhibited a dingy colour even on its peritoneal surface. Internally the mucous membrane appeared partially removed, as if by solution, at and near this part. This and some other parts which were coloured were of a brown or slate colour, the other parts of the stomach were pale and partially translucent. I have already noticed the small opake white scattered points which I have been induced to regard as follicles. Towards the pylorus the mucus on the surface of the membrane was more abundant and opake; the intestinal canal was not only of a whitish colour, as I have before stated, but the intestines were unusually firm as if filled with a pretty stiff pultaceous substance. On opening it, the coat appeared greatly thickened, but on examination this appearance was found to be produced by a thick opake white secretion deposited on the mucous surface, and bearing some similarity to a very thick white fur on

the dorsum of a tongue. When this was removed the pale and almost unchanged villous membrane was distinctly visible. The membrane was perhaps a little softened. When the secretion just mentioned was not of an opaque whitish colour, it was of a dusky brown of no great intensity. This colour was distinctly situated on the edges of the *valvulae conniventes*, and was in all probability produced by the action of the acid on the colouring matter of the blood with which the edges of the *valvulae conniventes* had been injected.

Not only the peculiar appearance which I have just described extended to all or to the greater part of the intestinal canal, but strong acid properties were manifested in it. This rapid diffusion of this noxious agent through so large a portion of the alimentary canal forms a striking contrast with those cases in which arsenic was the poison employed, in which, as it has already been stated, either no trace of the poison, or such only as were extremely faint, could be detected at more than a short distance beyond the pylorus, although the animal survived the administration of the poison for some hours. It would seem that this extent of the diffusion of the noxious agent is commonly the case with acid poisons and may be regarded as characteristic*.

The blood in the mesenteric veins was of a dark colour, confirming the observations of Dr. A. T. Thompson and Dr. Perry of Lausanne. It also appeared to possess acid properties. In observing the effect of oxalic acid on the stomach of the dog, as seen in this case, one can scarcely fail to be struck with the strong resemblance which it bears to the state of the human stomach as often seen in *post mortem* examinations, more especially with respect to the coloured and softened texture of the mucous membrane. The peculiarities in both of these respects have been strongly insisted upon as indicative of chronic inflammation. They unquestionably may be met with when this state has existed, but if I am not greatly mistaken they also occur when this has not been the case, and they may with much more probability be referred to the action of the juices of the stomach, which vary greatly in their properties, and doubtless act not only after death, but even in some degree before life is quite extinct.

No. 8. The last case which I have to bring forward is that of poisoning by spirits of wine. In investigating the action of poisons, it was next to impossible to lose sight of an agent, which not only involves many in inextricable misery, but hurries thousands to their graves.

Rather more than an ounce of strong spirit was injected into the stomach of a dog, as in the case of the experiment with boiling water. The effect was immediate. In a minute and a half he vomited mucus and a little blood; in three minutes he was wandering and falling in different directions; in five he fell down and voided a quantity of urine, the muscles of the abdomen and extremities were thrown into violent action;

• The mention of this fact to the Medical Section at the meeting in Edinburgh gave occasion to my friend Dr. William Thomson to show me a striking illustration of this principle in a representation of the effect of poisoning by nitric acid preserved in the splendid and extensive collection of pathological drawings in the possession of his father Dr. J. Thomson, Professor of Pathology.